SPATIAL MODELING OF MOSQUITO POPULATION DYNAMICS: AN OPERATIONAL TOOL FOR THE SURVEILLANCE OF VECTOR-BORNE DISEASES

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Context. Mosquitoes are vectors of major pathogens worldwide, such as the pathogens of Malaria, Chikungunya, dengue, Rift Valley or West Nile fevers. Accurate understanding and prediction of mosquito population dynamics are needed to optimize surveillance and control of mosquito-borne diseases.

Objectives. This study had two main objectives i) understanding the relationships between environmental conditions and mosquito population dynamics to predict mosquito densities and ii) developing operational tools for surveillance and control of vector-borne diseases, taking the example of Aedes albopictus in Reunion Island.
Methods. We developed different models using respectively process-based and data-based approaches to study the relationships between meteorological variables (daily temperature and rainfall), land cover classification derived from SPOT-6 imagery, and entomological collections of Aedes albopictus larvae from 9 sites located around the Island. The best models were implemented with Ocelet, a domain specific language and simulation tool for modelling changes in geographical landscapes, and a user-friendly interface was developed.

Results. The observed and predicted abundances of Aedes albopictus tallied very well. Spearman's correlation coefficients ranged between 0.45 and 0.90. Higher correlations were obtained in the sites with a higher seasonality of the mosquito population dynamics.

Conclusions. We developed a flexible and efficient tool that predicts mosquito abundance based on local environmental and meteorological factors. It is operational with a simplified, user-friendly interface and used by vector-control agencies to target surveillance areas in Reunion Island.

KEYWORDS: Land cover, classification, mosquito dynamics, modeling